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XI.—*Observations relative to the Geographical Position of the West Coast of South America.* By CARLOS MOESTA, Director of the National Observatory, Santiago de Chile, May 29, 1856.

Communicated by JOHN POWER, Esq., of Panama, F.R.G.S.

Read, June 14, 1858.

THE careful observations made by those in command of the several surveying vessels since the commencement of the present century, one of the objects being to fix the true geographical position of the West Coast of South America, refer principally to Valparaiso and Callao.

The longitudes of these two points have been determined by observations of celestial phenomena, or *the absolute method;* also by the transmission of mean time of Greenwich by chronometers, as was done, for example, in the important expedition commanded by Captain FitzRoy.

The longitudes of Callao and Valparaiso served to determine intermediate points between these two ports, also the coast of Equador and Panama, as well as that of many groups of islands in the Pacific. Thus, it will be seen, the great importance of knowing the exact longitude of Valparaiso and Callao in relation to the hydrography and geography of this portion of the globe.

During the last few years the port of Valparaiso has been in contact with Santiago by means of the electric telegraph, which has given us the most correct means of knowing the difference of meridian of the two places. It may be mentioned that the late experiments made as to the velocity of the electric fluid through a line of wire, show that it does not pass with the extraordinary rapidity supposed by Wheatstone; nevertheless, its passage is not less than 16,000 miles per second, and the time during which the electric fluid traverses the distance from Santiago to Valparaiso is not appreciable. In other words, a signal upon the key of the electric telegraph in Valparaiso may be transmitted to Santiago instantaneously, and *vice versâ.* Each beat of a second of a chronometer regulated to mean time of Valparaiso can be transmitted instantaneously to Santiago, and compared at the latter place with the time shown by a chronometer regulated for mean or time. The difference between these two times will give the difference of meridians of the two places. Thus it has been proved that the difference of longitude between Santiago and Valparaiso is 3m. 56·5s.

It may be mentioned, that this value expresses the difference between the meridian of the National Observatory of Santiago and that of the Tower of the Custom-house of Valparaiso, this last being only a few steps to the east of the Castillo de Rosario, to which is referred the longitude of Valparaiso as determined by FitzRoy.

I may state that I have obtained the same value by transmitting mean time from Santiago to Valparaiso by means of a good chronometer, carrying it in the hand in a gig. I purposely made this journey the 24th of October, 1853, in 17 hours, and the interval between the two comparings of the chronometer in both places was 29 hours.

The rate of the chronometer had not altered in the least during the journey, which is a proof that this method may be resorted to for the transmission of time with much exactness from one place to another, observing the necessary precautions.

It will be seen that the operation of determining the longitude of one place in respect to another by the electric telegraph is very easy, and the method much more correct than any previously employed. To give a proof of the exactitude obtainable by this method, we may mention that probably there are no other observatories in the world whose difference of meridian has been so minutely examined for the last two centuries as those of Greenwich and Paris. This difference has been determined by thousands of celestial observations, as well as by chronometric and geodesic: when Le Verrier and Airy determined it again in 1853 by the electric telegraph established at that period between the two countries, the result was a difference less than that previously calculated in nearly a second of time. This new method appears most important to us, for geography as well as for our knowledge of the figure of the earth, it being now possible to obtain the exact position of one point in respect to another on the surface of our globe, astronomically as well as geodesically, the results of which will give us the elements to determine the curvature of its surface when such operations may be necessary.

After this digression, I now return to the subject under consideration. The exact difference being known between the meridians of Valparaiso and Santiago, we may take the meridian of the last-mentioned place as a reference for all those of the coast which formerly have been referred to the meridian of Valparaiso. I will soon show the degree of exactitude with which we now know the position of the meridian of Santiago with respect to that of Greenwich, and I limit myself here to saying that, taking for the point of comparison the meridian of Santiago, the result is *that navigators have placed on their maps the West Coast of South America too far to the west.*

It may be interesting and even instructive to record briefly the results of the observations which from time to time since the commencement of the present century have been obtained by celebrated travellers for the longitudes of Valparaiso and Callao. I will commence with the observation which doubtless merits every confidence, namely, *that of the transit or passage of Mercury before the Sun's disc*, observed by Baron Humboldt, in Callao, the 9th of November, 1802. This observation compared with others on the same phenomenon made at Greenwich, Paris, Seeberg, Lilienthal, Berlin, Celle, and Copenhagen,* gave for the longitude of Callao $5^h\ 18^m\ 16^s$ to the west of Paris.

Later (during the years 1826 to 1836) the longitude of Valparaiso by the surveying expeditions under Captains King, Fitz-Roy, and Stokes. The result deduced from their observations of culminations of the moon, of occultations of the stars, and lunars taken at Valparaiso, gives for the longitude of the Castillo de Rosario† $4^h\ 56^m\ 6^s{\cdot}6$.

The same expedition determined the difference of longitude between Valparaiso and Callao by chronometers, and adopted for this element the value of $22^m\ 8^s{\cdot}4$, showing the longitude of Callao to be $5^h\ 18^m\ 15^s$; which result differed only 1 sec. from the first observation.

The foregoing observations were subsequently revised by Capt. Beechey,‡ and from his investigations the longitude of Valparaiso was $4^h\ 55^m\ 56^s{\cdot}2$, which would give for the longitude of Callao $5^h\ 18^m\ 4^s{\cdot}6$.

To the three determinations of the longitude of Callao already mentioned, I will add the last observed of importance, namely, that of the transit of Mercury the 4th of May, 1832, made by an excellent observer, Mr. Scholtz, in Lima, and Dr. Gallo, at the request of Humboldt. Mr. Scholtz deduced from this observation, comparing it with another made at Breslau of the same phenomenon, § the longitude of Lima to be $5^h\ 17^m\ 45^s$.

From this result we easily find the longitude of Callao, seeing that Humboldt had determined the difference of the meridian of Lima and that of Callao from November 9th to December 24th, 1802.‖ According to his observations, Callao is to the west of Lima $28^s{\cdot}7$.

Thus the result of the transit of Mercury in 1832 gave as the longitude of Callao $5^h\ 18^m\ 13^s{\cdot}7$. It will be seen that three of these results give, with a trifling difference, the same value for the longitude of Callao, and in view of this agreement we may believe that the longitude of Callao is now well known. Nevertheless by the observations made at our National Observatory, the result is, that the before-mentioned longitudes of Valparaiso and Callao are still affected by a considerable error. The longitude of the National Observatory is founded on a series of observations of moon culminations, and of stars, situated near its parallel (which are indicated in the Ephemeris), made at the end of 1852 with the great meridian circle of this establishment. The exactness of these last observations is without doubt greater than could have been obtained by the before-mentioned English scientific expeditions which had only portable instruments. For this reason the longitude of Santiago has been better determined. I have also compared my observations with corresponding ones made in several European observatories whose respective positions are known with the greatest accuracy.

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* *See* Humboldt, 'Recueil d'Observations Astronomiques,' vol. ii. pp. 421-427.

† *See* 'Journal of the Royal Geographical Society,' vol. vi. p. 337.

‡ *See* 'Naut. Mag.,' April, 1838.

§ *See* 'Astronomische Nachrichten,' No. 382.

‖ *See* Humboldt, 'Recu. d'Observ. Astr.,' tom. ii.

In this manner, not only no instrumental error, neither that of the lunar tables, could have any influence in the result of the said observations. Here, then, is the position of the meridian of the National Observatory of Santiago de Chile with respect to that of Greenwich :—

	h.	m.	s.
By 35 comparisons of moon culminations with Greenwich	4	42	31·5
17 do. do. do. Hamburgh	..		33·2
12 do. do. do. Kremsmünster	..		32·8
6 do. do. do. Cracow	..		34·7

From these different results, we deduce the longitude of Santiago de Chile to be to the west of Greenwich $4^{h}\ 42^{m}\ 32^{s}{\cdot}4$, and that of Valparaiso $4^{h}\ 46^{m}\ 28^{s}{\cdot}9$, and compared with Paris $4^{h}\ 55^{m}\ 49^{s}{\cdot}5$.

This value differs $17^{s}{\cdot}1$ from that adopted by the English expeditions for the longitude of Valparaiso; *and by this said quantity, in nearly all maps, the whole of the West Coast of South America is placed too far to the west.*

Taking into consideration the preceding observations, we have here the several longitudes compared with that of Greenwich :—

	h.	m.	s.
Santiago	4	42	32·4
Valparaiso	4	46	28·9
Callao	5	8	37·3
Lima	5	8	8·6

For vessels making long voyages in the Pacific, particularly if on a scientific mission, the knowledge of the exact longitude of Valparaiso is of great importance. Thus it will be expedient to give this new determination the necessary publicity, communicating the same to the hydrographic departments of the various maritime nations, and that our ministry of marine cause to be adopted the foregoing longitude of Valparaiso in the surveys the national marine may make on our coasts.